

CLAIMS

What is claimed is:

1. A system for use in treating of silicon wafers with chemicals during the manufacture of integrated circuits comprising:
 - 5 a process tank for cleaning, rinsing, and/or drying silicon wafers;
 - a first chemical supply vessel suitable for being pressurized, fluidly coupled to the process tank;
 - a chemical flow sensor for electronically monitoring the flow rate of chemical from the first chemical supply vessel;
 - 10 a first chemical flow metering valve for electronically controlling the flow rate of chemical from the first chemical supply vessel;
 - a supply of hot DI water fluidly coupled to the process tank;
 - a hot water metering valve for electronically controlling the flow rate of hot DI water from the supply of the hot DI water;
 - a supply of cold DI water fluidly coupled to the process tank;
 - a cold water metering means for electronically controlling the flow rate of cold DI water from the supply of cold DI water;
 - water flow sensor means for electronically monitoring the flow rate of DI water;
 - means for mixing the DI water and the first chemical to produce a solution of the first chemical in water;
 - 20 conductivity sensor means to electronically measure the conductivity of solution of the first chemical in water;
 - temperature sensor means to electronically measure the temperature of the solution being supplied to the process tank; and
 - 25 control means for automatically adjusting the precise flow rate, temperature, pressure, and chemical concentration of solution supplied to the process tank.

2. The apparatus of claim 1 wherein the means for mixing the DI water and the first chemical comprise a chemical injection valve and a static mixer.

3. The apparatus of claim 1 wherein the water flow sensor means is a total water flow sensor which is positioned to measure the flow of the combined hot DI water and cold DI water.

4. The apparatus of claim 1 wherein the water flow sensor means comprises a hot DI water flow sensor and a cold DI water flow sensor.

5. The apparatus of claim 1 further including a second chemical supply vessel suitable for being pressurized and fluidly coupled to the process tank, a second chemical flow sensor for electronically monitoring the flow rate of chemical from the second chemical supply vessel, and a second chemical flow metering valve for electronically controlling the flow rate of chemical from the second chemical supply vessel, means for mixing the second chemical with the solution of the first chemical in water, and a second conductivity sensor to electronically measure the conductivity of the solution of first and second chemical in water.

6. The apparatus of claim 5 further including a supply of nitrogen fluidly coupled to the first chemical supply vessel so as to pressurize the first chemical supply vessel and a supply of nitrogen fluidly coupled to the second chemical supply vessel so as to pressure the second chemical supply vessel.

7. The apparatus of claim 1 further including a supply of nitrogen fluidly coupled to the first chemical supply vessel so as to pressurize the first chemical supply vessel.

8. The apparatus of claim 1 further including a source of supply of first chemical to the first chemical supply vessel.

9. The apparatus of claim 1 wherein the control means is a programmed processor.

10. A method of injecting a solution of one or more chemicals in DI water into a process tank for cleaning, rinsing, and/or drying silicon wafers comprising:
pressurizing one or more chemical supply vessels fluidly coupled to the process tank;

monitoring and controlling the flow rate of each chemical from each supply vessel;
controlling the flow rate of hot DI water from a supply thereof;
controlling the flow rate of cold DI water from a supply thereof;
monitoring the flow rate of hot DI water from the supply thereof, cold DI water from the
5 supply thereof, and/or a mixture of combined hot and cold DI water;
mixing the hot and the cold DI water;
mixing the first chemical with the mixture of the hot and the cold DI water and measuring
the conductivity of the resultant solution of the first chemical in DI water;
measuring the temperature of the solution of first chemical and any additional
10 chemical(s) in DI water; and
controlling the precise flow rate, temperature, pressure, and chemical concentration of the
first and any additional chemicals in the solution supplied to the process tank.

11. The method of claim 10, further including mixing a second chemical with the
15 solution of the first chemical in DI water and measuring the conductivity of the resultant solution
of first and second chemical.

12. The method of claim 10, further including mixing a third chemical with the
20 solution of the first and second chemical in water and measuring the conductivity of the resultant
solution of first, second, and third chemicals in water.

13. The method of claim 10 wherein the chemical supply vessels are pressurized with
nitrogen.

25 14. The method of claim 10 wherein a selected temperature of solution supplied to the
process tank is obtained by continuously comparing the temperature of the solution being
supplied to the process tank and adjusting the proportion of flow rate of hot DI water to cold DI
water to achieve the desired temperature.

15. The method of claim 10 wherein a desired concentration of first chemical is achieved by adjusting the flow rate of the first chemical based on the conductivity of the solution of the first chemical in water.

5 16. The method of claim 10 wherein a desired concentration of first chemical is achieved by adjusting the flow rate of the first chemical based on the conductivity of the solution of the first chemical in water and the desired concentration of second chemical is achieved by adjusting the flow rate of the second chemical based on the conductivity of the solution of the first chemical and the conductivity of the solution of the first and second chemical.

10 17. The method of claim 10 wherein the first chemical is HF, and the additional chemicals comprise a second chemical which is HCl.

18. The method of claim 10 wherein the first chemical is HF, and the additional chemicals comprise a second chemical which is HCl, and a third chemical which is H₂O₂.